Instructions: Please answer all questions in the blue books. You may not use notes, books, or calculators. Please show your work. There are a total of seven questions, for 100 points. Questions vary in their level of difficulty. Partial credit will be given for partially correct answers. Good luck!

1) [10 points] Chapter 9 of the textbook discusses three key technologies/industries that were central to the industrial revolution. Name two of them. (You may only give two answers!)

2) [15 points] If a county’s human and physical capital per capita each double over the course of 100 years and output per capita increases by a factor of 8, by what factor did productivity increase over this period? You should make the standard assumptions that we have been making about the production function.

3) [15 points] In a certain country, education is very effective. In fact, education is so effective that each year of education that an individual receives doubles his/her wage. In this country, ¼ of the labor force has zero years of schooling; ¼ has one year of schooling; ¼ has two years of schooling; and ¼ has three years of schooling. What fraction of wages in this economy represent payment to human capital, and what fraction represent payment to raw labor?

4) [15 points] Consider two countries described by the model of technology spillovers in Chapter 8. The two countries have equal sized labor forces. Initially, Country Z has a higher value of $γ_A$ than does country X. The values of $γ_A$ have been constant for a long period of time. Suddenly, at time $t$, country Z lowers its value of $γ_A$ so that it is lower than the value in country X (while country X holds its value constant).

Draw a picture with time on the horizontal axis and the growth rates of $A$ in both countries on the vertical axis. Draw curves showing the how the growth rates in each country change over time, starting before time $t$, and continuing as they approach a new steady state. Be as careful as you can in indicating when growth in a country is rising, falling, or flat, when it jumps, and so on. You may include other figures in your answer if it is helpful in explaining your answer, but the main thing should be the figure just described.
5) [15 points] In discussing the development accounting exercise (chapter 7) we noted that human capital per worker differs less among countries than does physical capital per worker. For example, the countries with the highest and lowest values of human capital differ in $h$ by a factor of two or so, while the countries with the highest and lowest values of $k$ differ in that dimension by a factor of more than 20.

Given this observation, suppose that we re-did the development accounting exercise using a higher value of $\alpha$ in the production function – for example, using one half instead of one third. Would making this change in $\alpha$ be likely to raise or lower the fraction of cross country income variation that is due to productivity? Explain how you got your answer.

6) [15 points] An economist dies and goes to heaven. In heaven, God tells her to go ahead and ask any question that she wants. She says “Back on earth I was very interested in the cross country correlation of average health and average income. I always wondered which was right, the ‘health view’ or the ‘income view’ as described in the Weil textbook.” God replies, “Rather than answer you directly, let me tell you a story. In another solar system, I created a planet that was very similar to earth. On that planet, however, the scientific and industrial revolutions took place in a tropical country, and it was colonists from the tropics who expanded their hegemony to the rest of the planet. By the end of their 20th century, the correlation between income and distance from the equator was negative. However, on this planet, the relationship between income and health in cross country data looked very similar to your earth.”

“Thank you,” says the economist. “Now I know the answer.”

Explain what the answer was (i.e. the health or income view) and how God’s story implied it.

7) [15 points] Consider a country described by the one-country model of technological progress in Chapter 8. The technology production function is

$$\hat{A} = \frac{L_{t}}{\mu}$$

Suppose that the labor force, $L$, is equal to one. The value of $\mu$ is 50.

Suppose that for a long time, the value of $L_{t}$ has been zero – that is, the country has been doing no R&D. Starting in the year 2020, the country devotes half of its labor force to doing R&D. Draw a picture of output in the country over time. In what year will output return to its 2020 level?